

Macromolecules Concept Questions

1. Explain the relationship between monomers and polymers, using polysaccharides as an example. (Polymers are large molecules made up of a chain of smaller molecules called monomers. Monosaccharides are joined together to form polysaccharides.)
2. a) Plants make a huge amount of cellulose each year which could be an excellent source of glucose as food for humans and other organisms. Why is it not? (The $\beta 1 \rightarrow 4$ links between glucose molecules can't be hydrolyzed by our enzymes.)
b) Although it can't be digested, why is fibre (*i.e.*, cellulose) considered to be an important part of a healthy diet? (Fiber is not digestible so it fills the colon faster making more frequent bowel movements. This removes toxins and possible carcinogenic compounds from the colon.)
c) Wait a second, grass is the major part of the diet of herbivores like cows. How can they digest it? (In the gut of cows and other herbivores there are microbes that are able to digest cellulose because they contain enzymes that can metabolize $\beta 1 \rightarrow 4$)
3. Lipids and carbohydrates can both be used as energy by cells. If you need quick energy, which might you choose to eat? (Carbohydrates are metabolized more quickly than lipids.)
4. Which of these things is not like the others?
a) fiber (b) sugar (c) starch (d) cellulose (e) fat (Fat is not like the others because it is not a carbohydrate.)
5. How does the structure of an unsaturated fatty acid differ from the structure of a saturated fatty acid? Give an example of a food that contains each. (Unsaturated fats contain double bonds. Animals (except for some fish fats) produce saturated fats. Plants produce unsaturated fats.)
6. Explain why some fatty acids are solid at room temperature while others are liquid. (Saturated fatty acids are relatively straight so they pack closely together and are solid at room temperature. The double bonds of unsaturated fats cause kinks so they don't pack as closely and are liquid at room temperature.)
7. When you consume more food than you need for energy, the excess can be stored in the form of lipids. Why are lipids particularly useful for this purpose? (Lipids store more than twice the energy of carbohydrates.)
8. a) What property do all lipids share? (All lipids are hydrophobic.)
b) How does this make them ideal for building cell membranes? (The amphipathic nature makes them form a bilayer.)
9. What effect does hydrogenation have on fatty acids? (Hydrogenation converts an unsaturated fat to saturated by adding hydrogen to the double bonds. This makes the fat more solid.)
10. a) Cholesterol usually gets a bad rap in the media. What makes it a health risk? (Cholesterol is nonpolar so tends to accumulate on arterial walls, making them narrower and increasing blood pressure. This also increases the risk of stroke and heart attack.)
b) Should we try to eliminate it from our diet? (Our cells are able to manufacture all the cholesterol they need so any dietary cholesterol is excess.)
c) Do we need cholesterol? (Cholesterol is a necessary component in cell membranes and is used to produce some hormones.)
11. a) Why is a protein called a polypeptide? (A protein consists of many amino acids joined by peptide bonds.)
b) Why is a polypeptide not a protein? (To be a functional protein, a polypeptide has to be folded into a specific shape.)
12. Why are some amino acids soluble in water while others are not? (An amino acid with a polar R group would be polar and hydrophilic. One with a non-polar R group would be non-polar and hydrophobic.)
13. Although some people are vegetarians and therefore not eating meat, why do they need to make sure to include meat alternates in their diet? (Humans cannot synthesize all amino acids and so we must get them in our diet. In order to get all amino acids and sufficient protein, one must eat a variety of plant products and meat alternatives.)
14. Explain how the 3-dimensional shape of proteins is formed. (Interactions between the R groups of amino acids hold the polypeptide in its correct shape.)

15. Discuss a couple of the interactions that can occur between the R groups of an amino acid sequence. (Students could choose to discuss electrostatic interactions (*i.e.*, ionic bonds), hydrophobic interactions, disulfide bridges, or H-bonds.)
16. a) Some parts of amino acids are common to all amino acids while other parts are unique. Explain (All amino acids have an amino group and an acid group but each differs in its unique R group. They are all similar so they can bond together but different so they interact differently in different environments.)
b) How does having different R groups make amino acids ideal building blocks for proteins? (Different R groups behave differently in different environments and form different interactions. This allows a protein to function in a particular environment.)
17. a) Which elements are found in proteins but in neither carbohydrates nor lipids. (Nitrogen and sulfur.)
b) Which element is found in nucleic acids but in neither carbohydrates nor proteins? (Phosphorus.)
18. Name the basic building blocks for each of the following molecules:
a) Protein _____ (Amino acids.) (b) Triglyceride _____ (Glycerol and 3 fatty acids.) (c) Carbohydrate _____ (Monosaccharides.) (d) Nucleic acids _____ (Nucleotides.)
19. Proteins are to amino acids as polysaccharides are to _____. (Monosaccharides.)
20. a) You connect a molecule of ribose, a phosphate, and a molecule of cytosine. What have you made? (You have made a RNA nucleotide.)
b) Why can you not say you've made a nucleic acid? (A nucleic acid is a polymer of nucleotides.)